PATENT ABSTRACTS OF JAPAN

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(54) FOCUS PULLING-IN DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To suppress vibrations of a pickup lens, and to make it possible to turn on a focus servo by pulling in the focus surely and in a short time by sinusoidally varying a deviation of the lens with time in the direction of a distance of an optical recording medium at the time of pulling in a focus servo.

SOLUTION: A sinusoidal wave generating circuit generates a signal for controlling a distance between a pickup with a lens and a recording surface of an optical record medium for pulling in a focus. This signal voltage sinusoidally varies with time based on a sinisoidal table in a ROM. The pickup drives this signal to perform simple harmonic motion vertically to the recording surface of the optical record medium via a low-pass filter, a change-over switch, and a driving circuit. Thus, it is possible to speedily pull in the focus and transition to a focus servo state by suppressing swaying motion of the pickup, namely, swaying motion of the lens, when the pickup turns from ascending to descending, or from descending to ascending.

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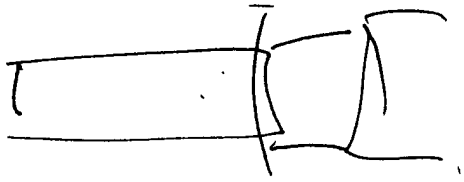

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CLAIMS

[Claim(s)]
[Claim 1] Focal drawing-in equipment characterized by having the lens actuator which moves the above-mentioned lens in the focal drawing-in equipment which draws the focus servo of the lens which condenses a light beam in up to an optical recording medium at the time of drawing in of a focus servo so that the variation rate of the above-mentioned lens in a range direction with an optical recording medium may change in the shape of a sine wave with time.
[Claim 2] Focal drawing-in equipment according to claim 1 characterized by having had the sinusoidal generating section which the above-mentioned lens actuator makes generate the driving signal for driving the above-mentioned lens from which an electrical potential difference changes in the shape of a sine wave with time amount, and equipping the above-mentioned sinusoidal generating section with the sinusoidal table for generating the above-mentioned driving signal in ROM.
[Claim 3] Focal drawing-in equipment according to claim 2 characterized by having the low pass filter into which the signal outputted based on the sinusoidal table in Above ROM is inputted.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the focal drawing-in equipment which draws the focus servo in the record regenerative apparatus to optical recording media, such as an optical disk.
[0002]
[Description of the Prior Art] The conventional technique is explained using drawing 5 and drawing 6 . 31 is a lens up-and-down signal generator. Curves A, B, and C are the signal of a circuit changing switch 37, the focal drive signal of a driver circuit 32, and a focal error signal detected by pickup 33 among drawing 6 , respectively.
[0003] The signal generated with the lens up-and-down signal generator 31 is sent to pickup 33 through a driver circuit 32. Pickup 33 equips optical recording media, such as a disk, with the lens which makes a light beam condense and which is not illustrated, and begins lifting toward an optical recording medium with the rise signal generated with the lens up-and-down signal generator 31. At this time, in a focal error signal, change called a S character curve (a shows among drawing 6) at the focusing point of a lens appears, and it is sent to the equalizer circuit 35 or the focal ON detector 36 through the RF (RF) amplifier 34 at it.
[0004] Then, a down signal is shortly sent from the lens up-and-down signal generator 31, and pickup 33 begins to descend. When the lens of pickup 33 reaches a focusing point exactly, the focal ON detector 36 works, a circuit changing switch 37 changes from the lens up-and-down signal generator 31 to the equalizer circuit 35, a focus servo turns on, and it becomes playback actuation.
[0005] In addition, this lens up-and-down signal raises an electrical potential difference simply, raises a lens, lowers an electrical potential difference simply, and drops a lens so that the focal drive signal shown in drawing 6 may usually show. That is, with time amount, an electrical potential difference increases linearly and decreases linearly from the peak of an electrical potential difference again.
[0006]
[Problem(s) to be Solved by the Invention] However, in a Prior art, it is accompanied by rapid rate change from lifting to descent during migration of pickup 33. Therefore, as b shows among drawing 6 , pickup 33 will vibrate and a lens will vibrate. For this reason, there is a fault that focal drawing in will take time amount, or drawing in will go wrong when the worst.
[0007] The method of suppressing an oscillation as much as possible is taken by making small movement magnitude [per / approach, i.e., unit time amount, of being made to perform lifting and descent of pickup slowly] of pickup, and conventionally, moving pickup at a low speed, in order to avoid this if possible. However, when a rate is reduced in this way, there is a problem of taking time amount until pickup will not reach very much to the location which a focus suits and a focus servo turns on shortly (initiation).
[0008] This invention is made in view of the above-mentioned trouble, and the object is in suppressing an oscillation of the lens of pickup and offering the focal drawing-in equipment which it is a short time certainly, and a focus can be drawn [equipment] and can make a focus servo turn on.

[0009]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, focal drawing-in equipment according to claim 1 is characterized by having the lens actuator which moves the above-mentioned lens at the time of drawing in of a focus servo so that the variation rate of the above-mentioned lens in a range direction with an optical recording medium may change in the shape of a sine wave with time in the focal drawing-in equipment which draws the focus servo of the lens which condenses a light beam in up to an optical recording medium.
[0010] By the above-mentioned configuration, at the time of drawing in of a focus servo, the above-mentioned lens is moved so that the variation rate of the above-mentioned lens [in / in a lens actuator / a range direction with an optical recording medium] may change in the shape of a sine wave with time. When a lens approaches lifting, i.e., an optical recording medium, the variation rate of a lens reaches the peak of a sinusoidal configuration soon, and, subsequently decreases. That is, a lens changes from lifting to descent. Here, a change of the variation rate of a lens with time is a sine wave-like as mentioned above, and rate change of a lens is also a sine wave-like with time. For this reason, rate change of the lens when changing the migration direction can be made loose.
[0011] For this configuration, the sinusoidal generating section generates the driving signal with which an electrical potential difference changes in the shape of a sine wave with time amount, and the above-mentioned lens is driven with this driving signal. Consequently, the acceleration of a lens changes in the shape of a cosine wave with time, and the rate of a lens changes in the shape of a sine wave with time. For example, at the time of lifting of a lens, if an actuation signal level increases, the peak of a sinusoidal configuration is reached and it subsequently decreases, a lens will change from lifting to descent. Here, since an actuation signal level is a sine wave-like as mentioned above, when an electrical potential difference approaches one peak with time amount unlike fluctuating an electrical potential difference linearly, electrical-potential-difference change of the time of passing over the peak from from is loose. For this reason, rate change of a lens in case the migration direction changes can be made loose.

[0012] Therefore, an oscillation of a lens can be suppressed extremely. So, an oscillation of a lens can be suppressed, a focus can be drawn certainly in a short time, and a focus servo can be made to turn on.
[0013] Focal drawing-in equipment according to claim 2 is characterized by having had the sinusoidal generating section which the above-mentioned lens actuator makes generate the driving signal for driving the above-mentioned lens from which an electrical potential difference changes in the shape of a sine wave with time amount in addition to the configuration of claim 1, and equipping the above-mentioned sinusoidal generating section with the sinusoidal table for generating the above-mentioned driving signal in ROM (read only memory).
[0014] By the above-mentioned configuration, in the above-mentioned sinusoidal generating section, a sine wave is generated based on the above-mentioned sinusoidal table, and focal drawing in is performed. Therefore, a complicated operation becomes unnecessary. Moreover, since Above ROM can be carried out by software in the conventional DSP for servoes (digital signal processor), its increment in hardware is unnecessary.
[0015] So, in addition to the effectiveness by the configuration of claim 1, a cost rise can be prevented.
[0016] Focal drawing-in equipment according to claim 3 is characterized by having the low pass filter (LPF) into which the signal outputted based on the sinusoidal table in Above ROM is inputted in addition to the configuration of claim 2.
[0017] Only a low frequency component is taken out from a signal as shown to the above-mentioned sinusoidal table by the above-mentioned configuration with the above-mentioned low pass filter. Therefore, the signal-level wave which approached in the shape of [more perfect] a sine wave is generated. Therefore, the granularity of the sinusoidal table in ROM can be eased and covered.
[0018] Moreover, since the above-mentioned low pass filter can be carried out by software in the conventional DSP for servoes, its increment in hardware is unnecessary.
[0019] So, a focus is further controllable to a precision, preventing a cost rise in addition to the effectiveness by the configuration of claim 2.

[0020]
[Embodiment of the Invention] It will be as follows if one gestalt of operation of this invention is explained based on drawing 1 R> 1 thru/or drawing 4 . First, the configuration of the focal drawing-in equipment concerning this operation gestalt is explained using drawing 1 . Pickup 3 is equipped with the lens illustrated for making the light beam of business, such as record playback, condense neither to CD (compact disk) nor an optical recording medium like MD (mini disc) which is not illustrated. This equipment drives pickup 3 and performs focal drawing in of a lens so that the above-mentioned lens may make a light beam focus on the recording surface of an optical recording medium.
[0021] The sinusoidal generating circuit 1 generates the signal which controls the distance of pickup 3 and the recording surface of an optical recording medium for this focal drawing in. As for the above-mentioned signal, an electrical potential difference changes in the shape of a sine wave with time amount. The sinusoidal generating circuit 1 has ROM(read only memory)1a in the interior, and the sinusoidal table is stored in ROM1a. The above-mentioned sinusoidal table describes beforehand a response with the output voltage which should be outputted to each time of day and its time of day so that it may become the sinusoidal configuration which the output signal electrical potential difference from the sinusoidal generating circuit 1 described above.
[0022] The signal which the output signal of the sinusoidal generating circuit 1 was inputted, and was processed by LPF8 is outputted for LPF (low pass filter)8 to a driver circuit 2 through a circuit changing switch 7.
[0023] A driver circuit 2 outputs the focal drive signal (driving signal) for driving so that it may keep away to pickup 3 so that it is based on the output signal of the above-mentioned sinusoidal generating circuit 1, and an optical recording medium may be approached to an optical recording medium in pickup 3 in order to make the above-mentioned light beam condense and focus.
[0024] Pickup 3 detects the light which irradiates a light beam with the above-mentioned lens at an optical recording medium, and is outputted from an optical recording medium as mentioned above, and performs record and playback. Pickup 3 produces the acceleration proportional to the above-mentioned driving signal in the range direction to an optical recording medium.
[0025] The detecting signal which pickup 3 outputs according to the detection light from an optical recording medium is inputted, and RF amplifier 4 outputs it to the equalizer circuit 5 and the focal ON detector 6.
[0026] The above-mentioned circuit changing switch 7 changes the input from LPF8, and the input from the focal ON detector 6.
[0027] The above-mentioned sinusoidal generating circuit 1, LPF8, the circuit changing switch 7, the focal ON detector 6, and the equalizer circuit 5 are formed in DSP (digital signal processor)10. Moreover, the sinusoidal generating section is constituted by the above-mentioned sinusoidal generating circuit 1 and LPF8, and the lens actuator is constituted by the sinusoidal generating circuit 1, LPF8, a driver circuit 2, and pickup 3.
[0028] Next, actuation actuation of the pickup 3 by the above-mentioned configuration is explained. Curvilinear A-D explains the response of aging of each following signal level among drawing 2 . The scale of an axis of ordinate changes with signals. Curves A, B, C, and D are the output signal of a circuit changing switch 7, the output signal of the sinusoidal generating circuit 1, the output signal of LPF8, and a focal error signal detected by pickup 3, respectively.
[0029] First, a circuit changing switch 7 is set to HIGH as shown in the curve A of drawing 2 , and an input side is set to LFP8 side.
[0030] The sinusoidal generating circuit 1 outputs a stair-like signal as shown in the curve B of drawing 2 , referring to the sinusoidal table in ROM1a.
[0031] It is inputted into LPF8, only a low frequency component is taken out as an actuation component, and this signal turns into a signal which has the voltage waveform of the shape of a sine wave as shown in the curve C of drawing 2 . And it is outputted to a driver circuit 2 through a circuit changing switch 7, and is sent to pickup 3 as a focal drive signal. As shown in drawing 2 , according to the output signal of the sinusoidal generating circuit 1 based on the above-mentioned sinusoidal table, the output voltage of

LPF8 increases in the shape of a sine wave with time amount, greets a peak, starts to decrease in the shape of a sine wave, and greets a peak. This is repeated.
[0032] pickup 3 induces cosine wave-like acceleration with this focal drive signal, and has the rate which changes in the direction which changes distance with the recording surface of an optical recording medium in the shape of a sine wave with time vertically that is, to the recording surface of an optical recording medium -- ******** -- this sake -- time amount -- the shape of a sine wave -- migration -- that is, simple harmonic motion is carried out.
[0033] As mentioned above, motion of pickup 3 is simple harmonic motion, and harmonic content is not contained in the actuation component of pickup 3. Therefore, unless the natural frequency of pickup 3 and the frequency of the above-mentioned simple harmonic motion agree, pickup 3 cannot resonate. Therefore, this configuration is strong to resonance of pickup 3. That is, it is hard to generate resonance of pickup 3.
[0034] About the above-mentioned actuation, in more detail, first, this drives pickup 3, and if the signal level from the sinusoidal generating circuit 1 increases according to a sinusoidal configuration with time amount and the output voltage from LPF8 starts the increment in-like [sine wave] in connection with it, it will begin lifting from the lower part of an optical recording medium so that it may approach toward an optical recording medium.
[0035] If pickup 3 goes up till the place where a lens arrives at the location (focusing point) which makes a light beam focus on the recording surface of an optical recording medium in the middle of the increment in the output voltage of LPF8, in a focal error signal, change called a S character curve (a shows among drawing 2) will appear. And the information that this S character curve appeared is sent to the equalizer circuit 5 or the focal ON detector 6 through RF amplifier 4.
[0036] The output voltage of LPF8 continues an increment further, passes over the event of a lens reaching the above-mentioned focusing point, greets a peak as mentioned above after a while, and changes it to reduction. According to it, pickup 3 begins to descend so that it may separate from an optical recording medium.
[0037] Then, when a lens reaches the above-mentioned focusing point again exactly, the focal ON detector 6 detects it, the signal of a circuit changing switch 7 is made to change into the LOW side, as shown in the curve A of drawing 2 , and the input side of a circuit changing switch 7 is made to be changed from the sinusoidal generating circuit 1 side (LPF8 side) to the equalizer circuit 5. Then, a focus servo turns on and playback actuation is started.
[0038] In the former, during lifting, pickup will be rapidly slowed down, if an almost fixed high speed is maintained and the electrical potential difference of a focal drive signal reaches a peak, and if the electrical potential difference of a focal drive signal passes over a peak, the sense will be changed rapidly, it will accelerate rapidly and it will serve as an immediately almost fixed high speed.
[0039] On the other hand, with this above-mentioned operation gestalt, aging of the electrical potential difference of a focal drive signal which carries out vertical migration of the pickup 3 is a sine wave-like. That is, at the time of lifting actuation of pickup 3, with time amount, in the shape of a sine wave, the electrical potential difference of a focal drive signal approaches a peak, reaches a peak, and separates from a peak. For this reason, the acceleration of pickup 3 changes in the shape of a cosine wave with time, and the rate of pickup 3 changes in the shape of a sine wave with time in connection with it. That is, the climbing speed of pickup 3 decreases gradually, i.e., gently, according to the sinusoidal configuration with time amount as a location with the variation rate of pickup 3 nearest to an optical recording medium in the successive range of the pickup 3 in the peak by the side of lifting, i.e., a range direction with an optical recording medium, is approached. And a rate becomes zero when the variation rate of pickup 3 comes to the above-mentioned peak. Subsequently, the lowering speed of pickup 3 increases gradually, i.e., gently, according to the sinusoidal configuration with time amount as the sense is changed and the variation rate of pickup 3 separates from the peak. The rate of pickup 3 becomes max when the variation rate of pickup 3 is in the above-mentioned peak of a sinusoidal configuration, and the peak of another side, i.e., the center between the most distant locations from an optical recording medium in the above-mentioned successive range.

[0040] In addition, although the case where pickup 3 starts to descend from lifting is explained, about the time of changing to going up from descent, similarly, pickup 3 and a lens are gradually slowed down, if a lens approaches the peak of a variation rate, and if a lens subsequently begins to keep away from the peak of a variation rate, they are accelerated gradually here.
[0041] Thus, the rate change at the time of changing to going up with this operation gestalt from the time of changing to descending from lifting of pickup 3 or descent is loose. Therefore, pickup 3 can suppress remarkably the shake of pickup 3 when changing to going up from descent and descent, therefore the shake of a lens from lifting, can perform focal drawing in promptly, and can move to a focus servo condition.
[0042] Moreover, pickup 3 moves pickup 3 to a high speed enough in the medium of the above-mentioned peak of the sinusoidal configuration of the variation rate of pickup 3, and a peak in order to move at the rate which changes in the shape of a sine wave with time as mentioned above. For this reason, it is possible to make the lens of pickup 3 reach sufficiently promptly to the above-mentioned focusing point with this operation gestalt unlike slowing down pickup uniformly and always moving it like before, at a low speed.
[0043] Drawing 3 shows the result of having measured resonance of pickup 3 by the focal sine wave-like drive signal, based on the above-mentioned explanation, and drawing 4 expands the part (the inside of drawing 3 , center) from which it moves to a focus servo condition about drawing 3 . Curvilinear A-C explains the response of aging of each following signal level among drawing 3 and drawing 4 . The scale of an axis of ordinate changes with signals. Curves A, B, and C are the focal error signal detected by pickup 3, the focal drive signal which drives pickup 3, and the output signal of a circuit changing switch 7, respectively. HIGH of the output signal of a circuit changing switch 7 and LOW are equivalent to OFF of a focus servo, and ON, respectively. The oscillation of pickup 3 is suppressed and a focus servo can be quickly turned ON so that drawing 3 and drawing 4 may show.
[0044]
[Effect of the Invention] As mentioned above, focal drawing-in equipment according to claim 1 is the configuration equipped with the lens actuator which moves the above-mentioned lens at the time of drawing in of a focus servo so that the variation rate of the above-mentioned lens in a range direction with an optical recording medium may change in the shape of a sine wave with time in the focal drawing-in equipment which draws the focus servo of the lens which condenses a light beam in up to an optical recording medium.
[0045] So, the oscillation of pickup is suppressed and the effectiveness that a focus can be drawn and focal ON can be carried out certainly in a short time is done.
[0046] Focal drawing-in equipment according to claim 2 is the configuration that had the sinusoidal generating section which the above-mentioned lens actuator makes generate the driving signal for driving the above-mentioned lens from which an electrical potential difference changes in the shape of a sine wave with time amount in addition to the configuration of claim 1, and the above-mentioned sinusoidal generating section is equipped with the sinusoidal table for generating the above-mentioned driving signal in ROM.
[0047] So, in addition to the effectiveness by the configuration of claim 1, the effectiveness that a cost rise can be prevented is done.
[0048] Focal drawing-in equipment according to claim 3 is a configuration equipped with the low pass filter into which the signal outputted based on the sinusoidal table in Above ROM is inputted in addition to the configuration of claim 2.
[0049] So, the effectiveness that a focus is further controllable to a precision is done, preventing a cost rise in addition to the effectiveness by the configuration of claim 2.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the example of 1 configuration of the focal drawing-in equipment concerning this invention.
[Drawing 2] It is the graph which shows aging of each signal level.
[Drawing 3] It is the graph which shows aging of each signal level.
[Drawing 4] It is the graph which shows aging of each signal level.
[Drawing 5] It is the block diagram showing the example of a configuration of conventional focal drawing-in equipment.
[Drawing 6] It is the graph which shows aging of each signal level.
[Description of Notations]
1 Sinusoidal Generating Circuit (Lens Actuator, Sinusoidal Generating Section)
1a ROM
2 Driver Circuit (Lens Actuator)
3 Pickup (Lens Actuator)
4 RF Amplifier
5 Equalizer Circuit
6 Focal ON Detector
7 Circuit Changing Switch
8 LPF (Lens Actuator, Sinusoidal Generating Section)
10 DSP

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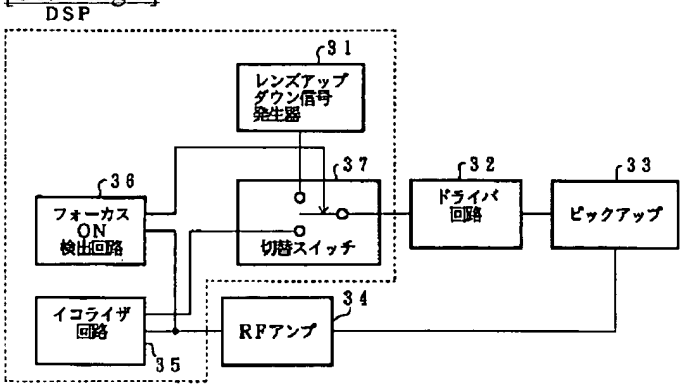
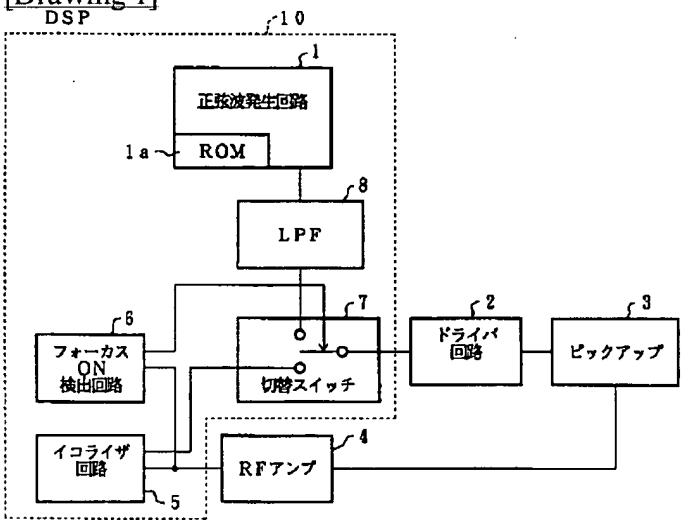
DRAWINGS

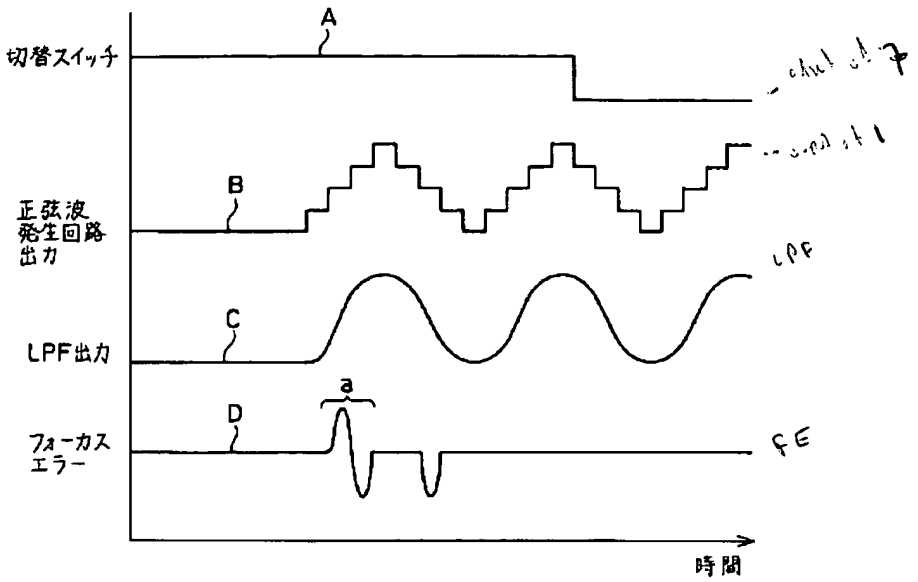
[Drawing 5]



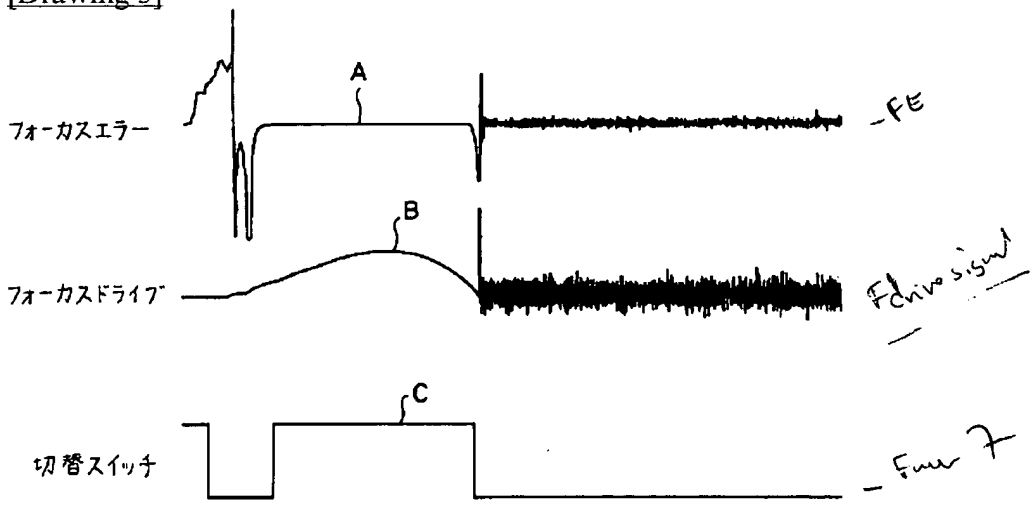
[Drawing 1]



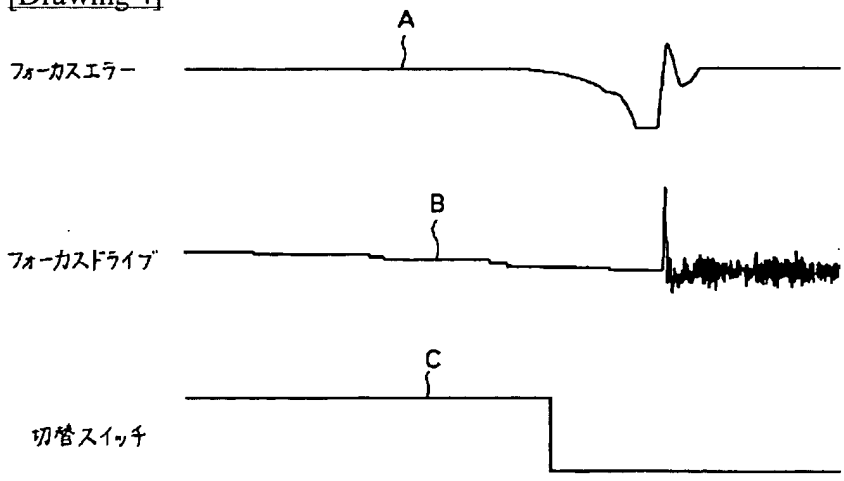
[Drawing 2]



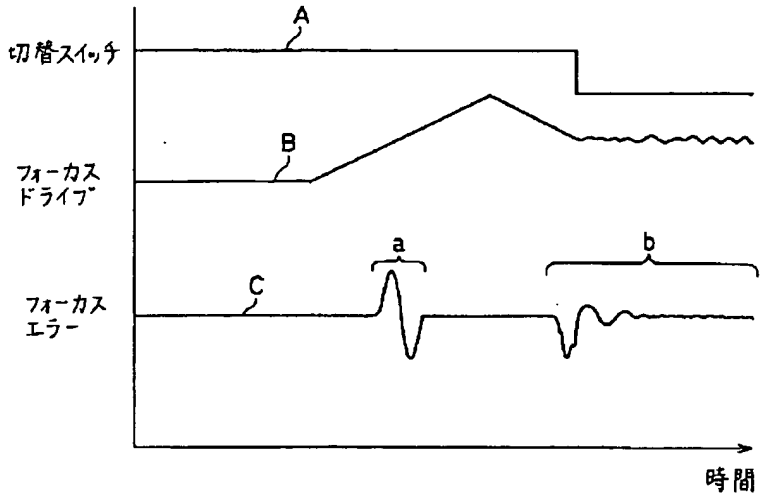
[Drawing 3]



[Drawing 4]



[Drawing 6]



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